



North Coast Regional Water Quality Control Board

Russian River Pathogen Indicator Bacteria TMDL

August 28, 2014



Meeting Outline

- Opening Remarks
- Staff Presentation
 - Overview of the Russian River Watershed and TMDLs
 - Introduction of Bacteria Objective
 - Summary of Impacted Areas
 - Summary of Sources
 - Possible Implementation Actions
- Open Discussion of Possible Implementation Actions





What is a TMDL?

A **T**otal **M**aximum **D**aily **L**oad (**TMDL**) is:

- Maximum amount of a pollutant that waterbody can handle and remain healthy





What is a TMDL?

A **T**otal **M**aximum **D**aily **L**oad (**TMDL**) is a framework for:

- Evaluating and quantifying the factors that contribute to water quality problems in a waterbody or watershed
- Developing a strategy (called an Action Plan or Implementation Plan) to meet the loading capacity and attain water quality standards



End Goal: Attain Water Quality Standards

Standards include:

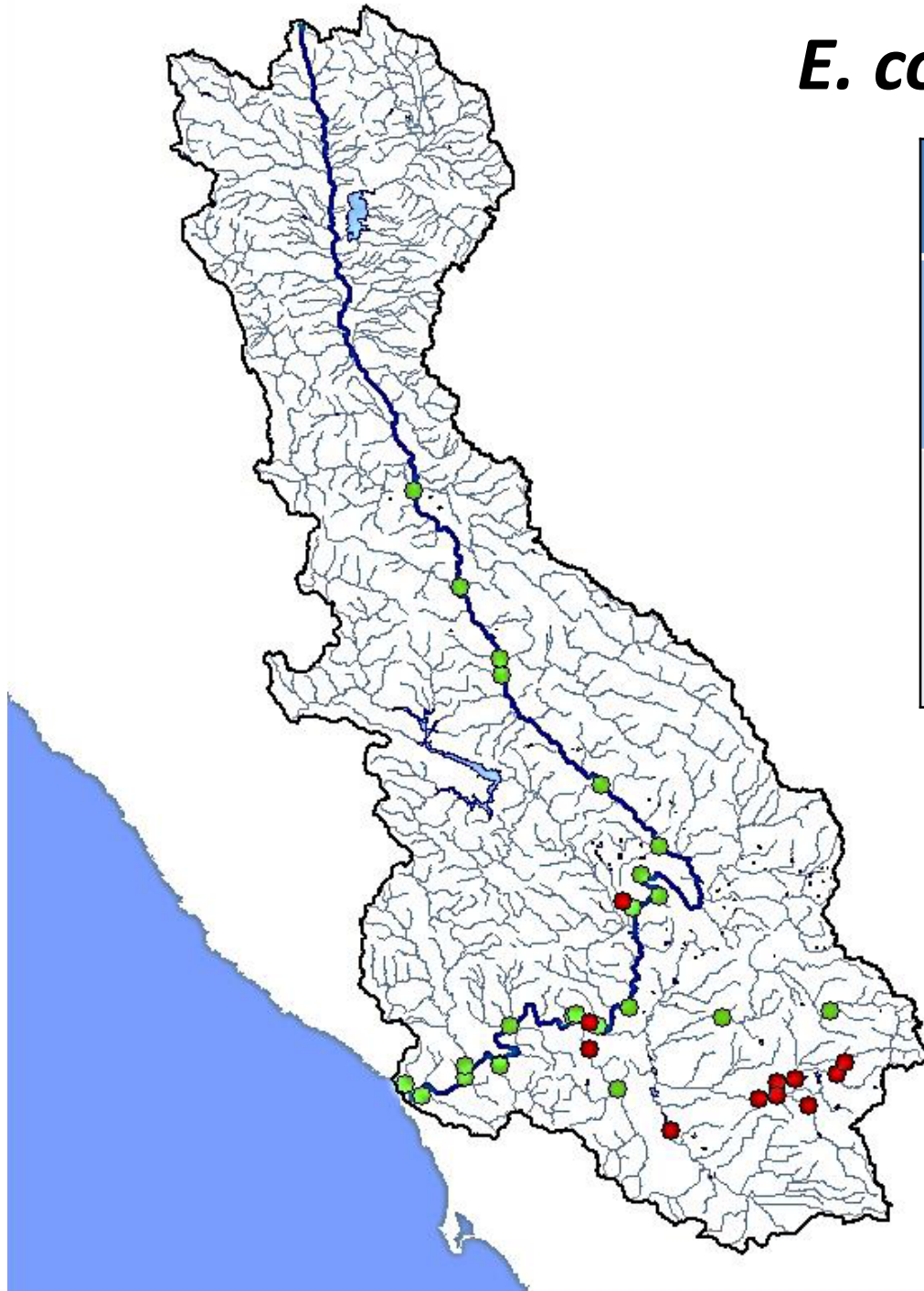
- Beneficial Uses of Water
 - Water Contact Recreation
- Water Quality Objectives
 - Bacteriological quality of the Russian River and its tributaries shall not be degraded beyond natural background conditions



Area of Impact

1. Waste from humans
2. Waste from other animals

E. coli Bacteria Distribution



E. coli REC-1 Criteria

	Geometric Mean	Statistical Threshold Value
Estimated 36 illnesses per 1,000 recreators	126 colony forming units / 100mL water	410 cfu/100mL

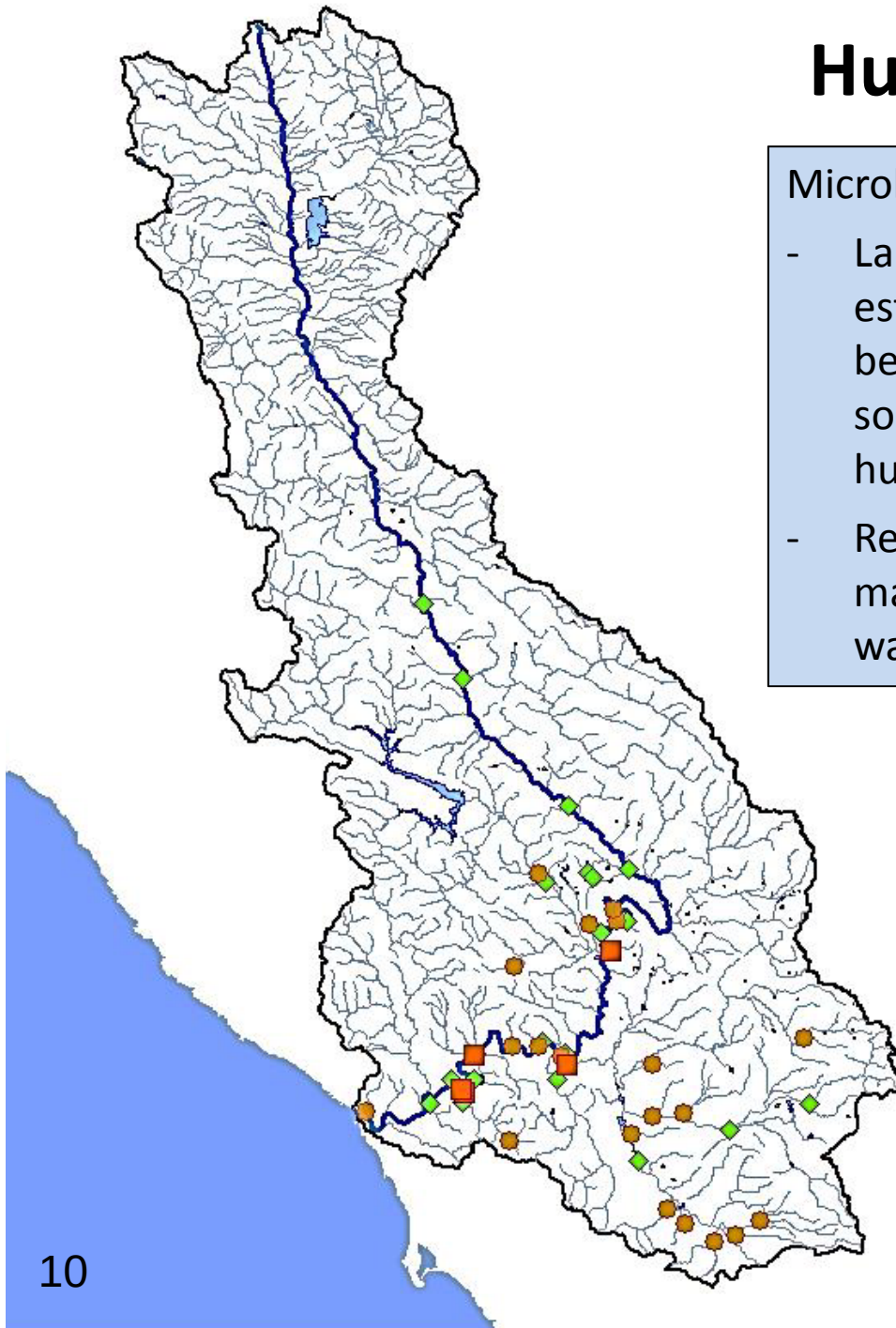
Russian River Watershed

- Exceeds REC-1 criteria
- Meets REC-1 criteria
- Mainstem Russian River

Human Waste Distribution

Microbiological Source Identification Facts:

- Lab analysis identifies DNA gene sequences to estimate the percent of bacteria DNA matches between water sample and a known fecal source (i.e., raw sewage, septic waste, and human feces)
- Results expressed as % of bacterial DNA that matches known bacterial DNA from human waste



Russian River Watershed

Percent Human Waste

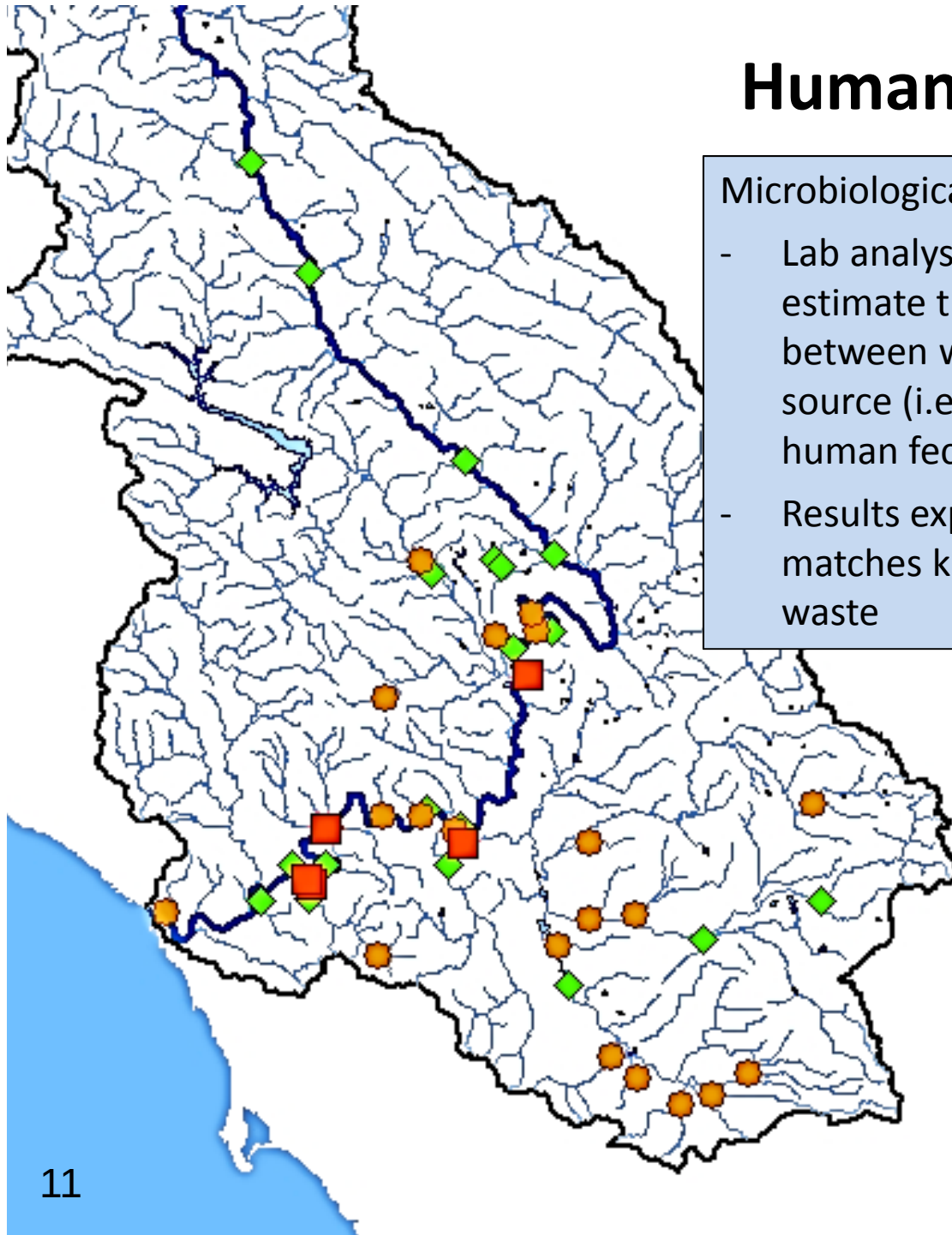
- ◆ < 5%
- 5% - 50%
- > 50%

— Mainstem Russian River

Human Waste Distribution

Microbiological Source Identification Facts:

- Lab analysis identifies DNA gene sequences to estimate the percent of bacteria DNA matches between water sample and a known fecal source (i.e., raw sewage, septic waste, and human feces)
- Results expressed as % of bacterial DNA that matches known bacterial DNA from human waste



Russian River Watershed

Percent Human Waste

- ◆ < 5%
- 5% - 50%
- > 50%

— Mainstem Russian River

Human *Bacteroides* Bacteria Distribution

Current Reporting Limit = 60 genes/100mL

Presence = Exceedance of Reporting Limit

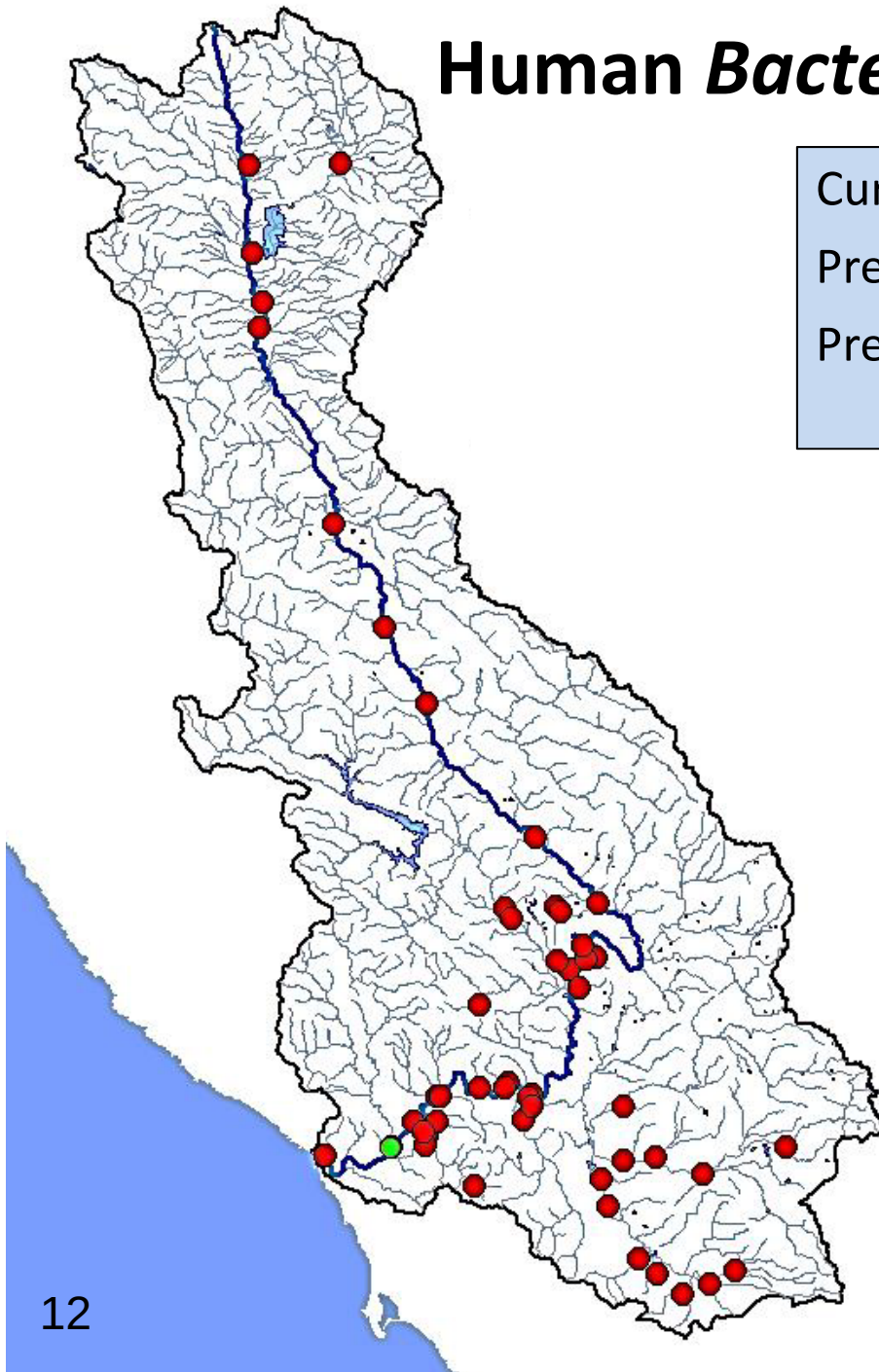
Presence = Exceedance of Natural Background
Bacteria Objective

Links between *Bacteroides* & Illness

	Wade et al. (2010)	Ashbolt et al. (2010)
Estimated 30 illnesses per 1,000 recreators	60 genes/100mL	860 genes/100mL

Russian River Watershed

- Measurements less than the Reporting Limit
- Measurements greater than the Reporting Limit
- Russian River Mainstem





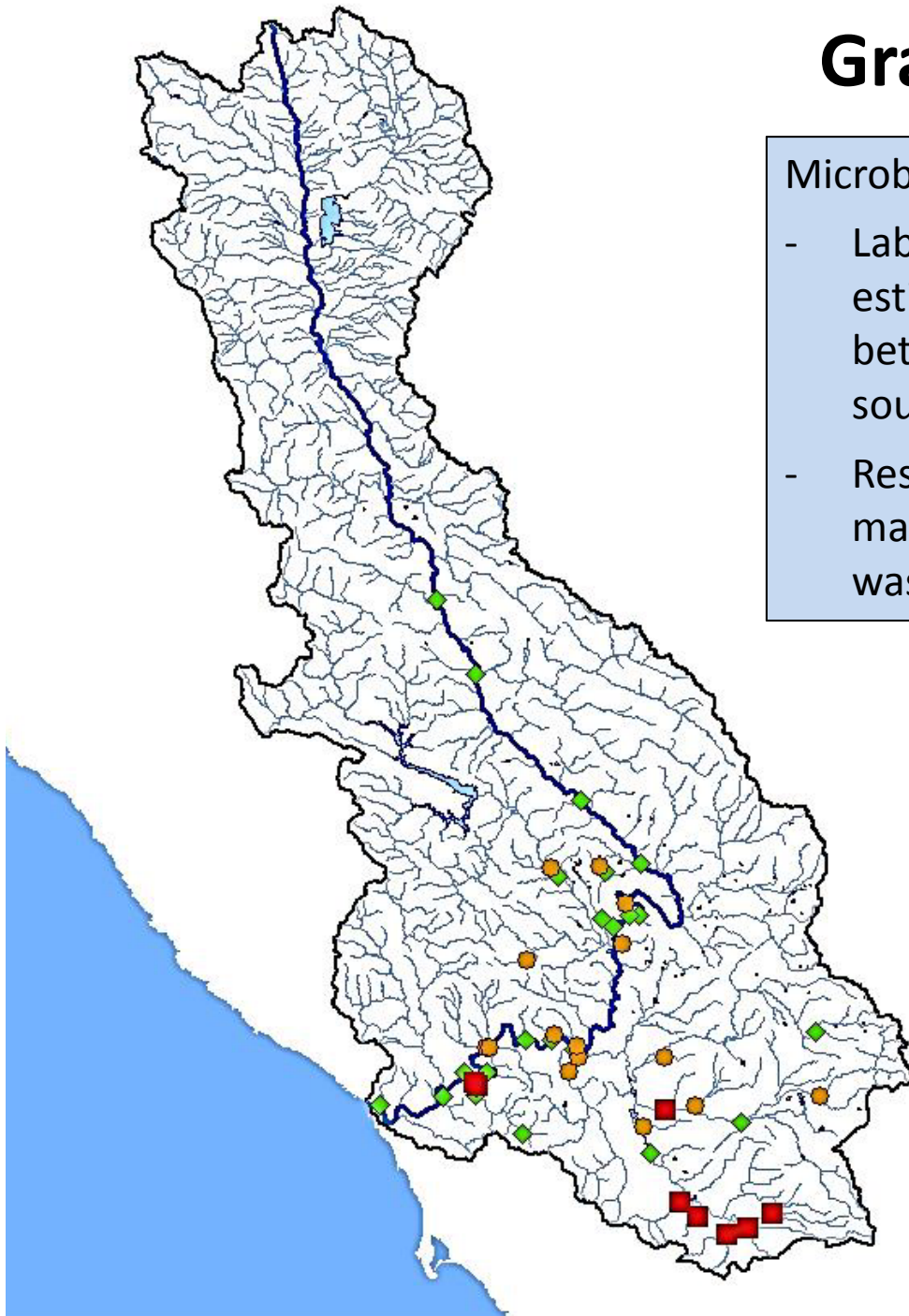
Area of Impact

1. Waste from humans
2. Waste from other animals

Grazer Waste Distribution

Microbiological Source Identification Facts:

- Lab analysis identifies DNA gene sequences to estimate the percent of bacteria DNA matches between water sample and a known fecal source (i.e., cows, horses, deer, and elk)
- Results expressed as % of bacterial DNA that matches known bacterial DNA from grazer waste



Russian River Watershed

Percent Grazer Waste

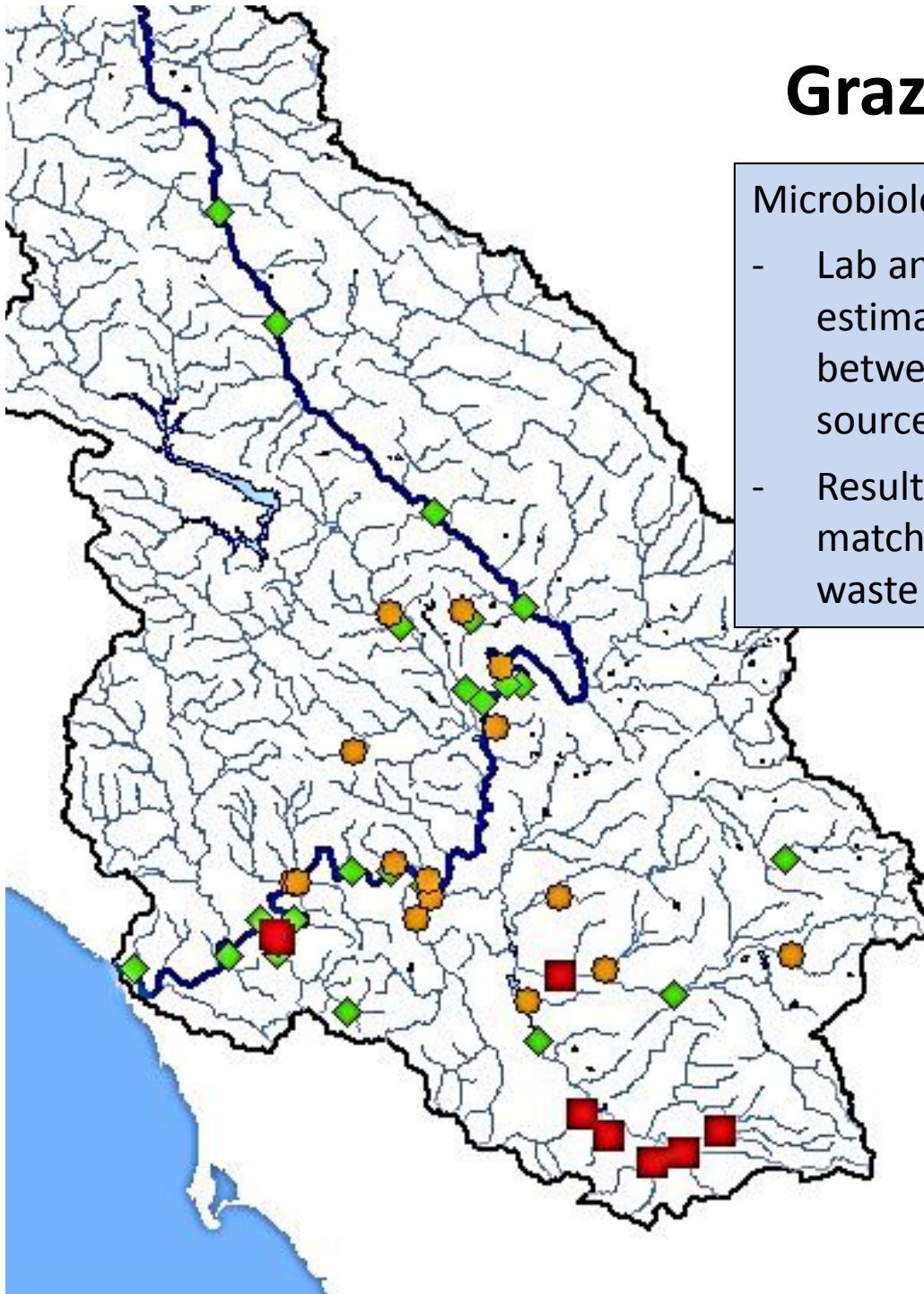
- ◆ < 5%
- 5% - 20%
- > 20%

— Mainstem Russian River

Grazer Waste Distribution

Microbiological Source Identification Facts:

- Lab analysis identifies DNA gene sequences to estimate the percent of bacteria DNA matches between water sample and a known fecal source (i.e., cows, horses, deer, and elk)
- Results expressed as % of bacterial DNA that matches known bacterial DNA from grazer waste



Russian River Watershed

Percent Grazer Waste

- ◆ < 5%
- 5% - 20%
- > 20%

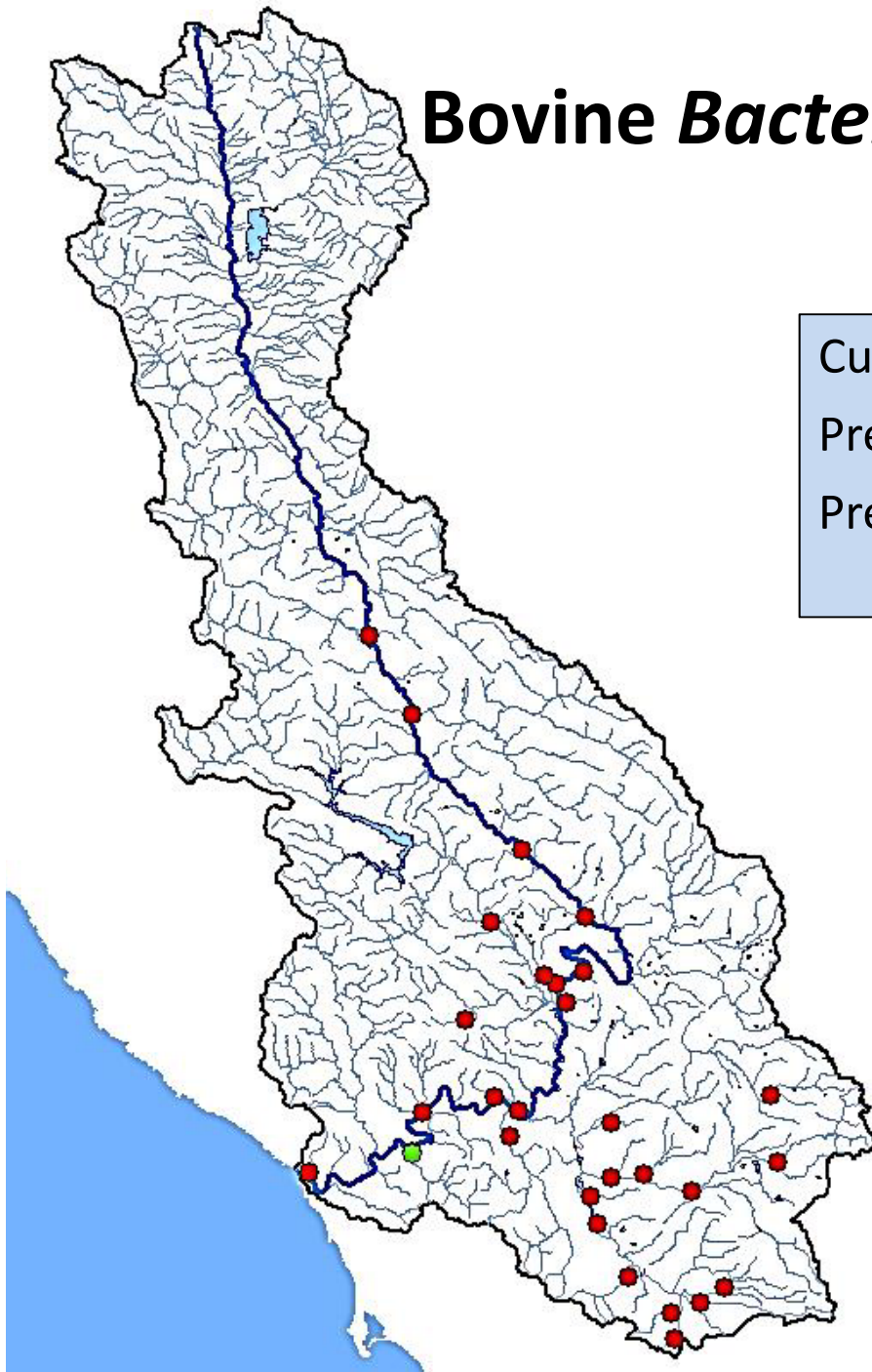
— Mainstem Russian River

Bovine *Bacteroides* Bacteria Distribution

Current Reporting Limit = 30 genes/100mL

Presence = Exceedance of Reporting Limit

Presence = Exceedance of Natural Background
Bacteria Objective



Russian River Watershed

- Measurements greater than the Reporting Limit
- Measurements less than the Reporting Limit
- Mainstem Russian River



Conclusions

1. Pathogens are likely present throughout the Russian River Watershed above natural background levels
2. Most significant impacts are in tributaries and the lower mainstem river

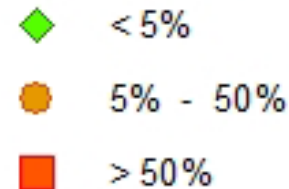
Human Waste Distribution

Microbiological Source Identification Facts:

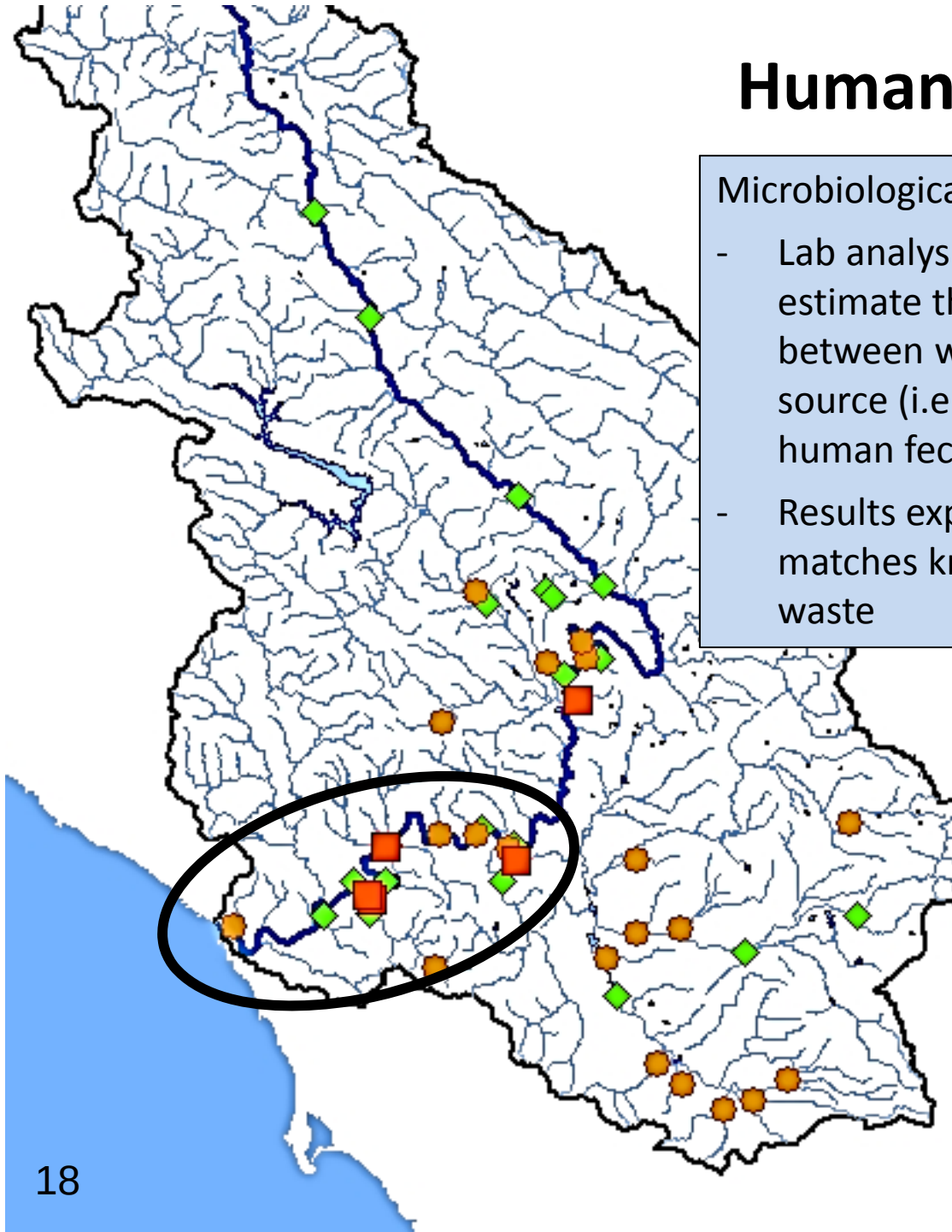
- Lab analysis identifies DNA gene sequences to estimate the percent of bacteria DNA matches between water sample and a known fecal source (i.e., raw sewage, septic waste, and human feces)
- Results expressed as % of bacterial DNA that matches known bacterial DNA from human waste

Russian River Watershed

Percent Human Waste



Blue line: Mainstem Russian River





Sources

- Sources are producing bacteria throughout the year
- Stormwater runoff is mobilizing the bacteria into waterbodies
- Bacteria levels are higher in developed areas than in less developed areas
- Bacteria levels are higher in runoff from catchments with a high density of onsite wastewater treatment systems than from areas with a low density of systems
- High recreational uses can result in high bacteria levels



Potential Implementation Actions

- Management of Onsite Wastewater Treatment Systems (Septic Systems)
- Management of Municipal Wastewater
- Management of Recreational Water Use
- Management of Human Waste from Homeless and Farmworker Encampments
- Management of Animal Waste



Onsite Wastewater Treatment Systems

- Actions for Sonoma and Mendocino counties to manage individual OWTS in accordance with the general framework established in the TMDL. The counties would develop and submit a Bacteria Load Reduction Plan for priority areas identified in the TMDL.
- Actions for municipalities and special districts to connect existing OWTS within their district boundaries and expand the boundaries where it is reasonable and feasible.
- Actions to regulate large OWTS within certain distance of mainstem and tributaries through waste discharge requirements.
- Encourage publicly-owned treatment works to develop regional program to collect and dispose of RV toilet waste from campgrounds.



Municipal Wastewater

- Establishment of effluent limitations for *E. coli* for municipal wastewater discharges
- Actions requiring municipalities and special districts to further minimize sanitary sewer overflows
- Actions requiring recycled water suppliers and users to further minimize spills and incidental runoff from recycled water use sites
- Actions requiring municipalities and special districts to improve management practices that prevent runoff from biosolids application areas



Recreational Water Use

- Actions encouraging counties to educate public about personal hygiene and public health dangers at recreational beaches.
- Actions encouraging counties to provide and maintain adequate and convenient public restroom facilities at known beach use areas.



Homeless and Farmworker Encampments

- Actions recommending that counties, municipalities, MS4s, and Caltrans prevent access to bridge overpasses and other areas that are known to attract illegal camping
- Actions recommending counties to fund and implement programs to address homelessness
- Actions recommending counties to investigate construction of public restrooms for use by homeless
- Actions recommending counties to enforce local ordinances prohibiting camping on public property
- Actions recommending counties to develop program to manage farmworker housing



Animal Waste

- Actions directing dairies enrolled under dairy waiver and/or dairy permit to improve management practices that prevent runoff from pasture lands.
- Actions directing counties to develop programs to manage pet waste.
- Establish requirements in municipal storm water permits that require management of pet waste.
- Establish requirements in municipal storm water permits to further reduce non-storm water runoff, including over-irrigation
- Actions directing counties to provide outreach to hobby farms and owners of non-dairy livestock



Questions to Consider

- Are any of the suggested implementation options reasonable? What might work?
- Are any of the suggested options infeasible? What might not work?
- What suggestions do you have to control bacteria and pathogens?
- How much time do you think this will take?
- How can we help?

Contact Information

Webpage:

http://www.waterboards.ca.gov/northcoast/water_issues/programs/tmdls/russian_river

Mailing List:

http://www.waterboards.ca.gov/resources/email_subscriptions/reg1_subscribe.shtml

Phone:

(707) 576-2220

E-mail:

Rebecca Fitzgerald, TMDL Unit Senior

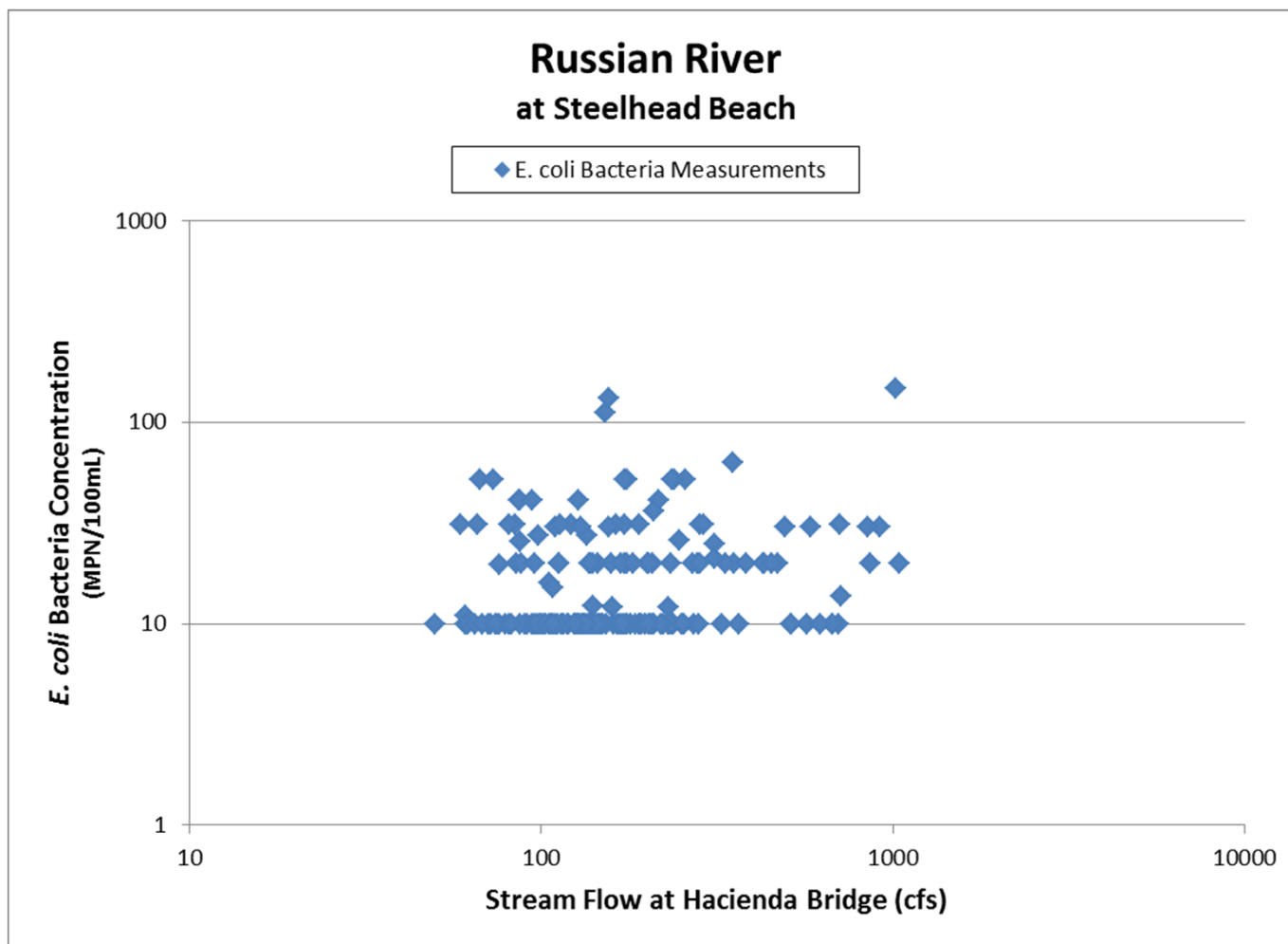
Charles Reed, Russian River TMDL Project Manager

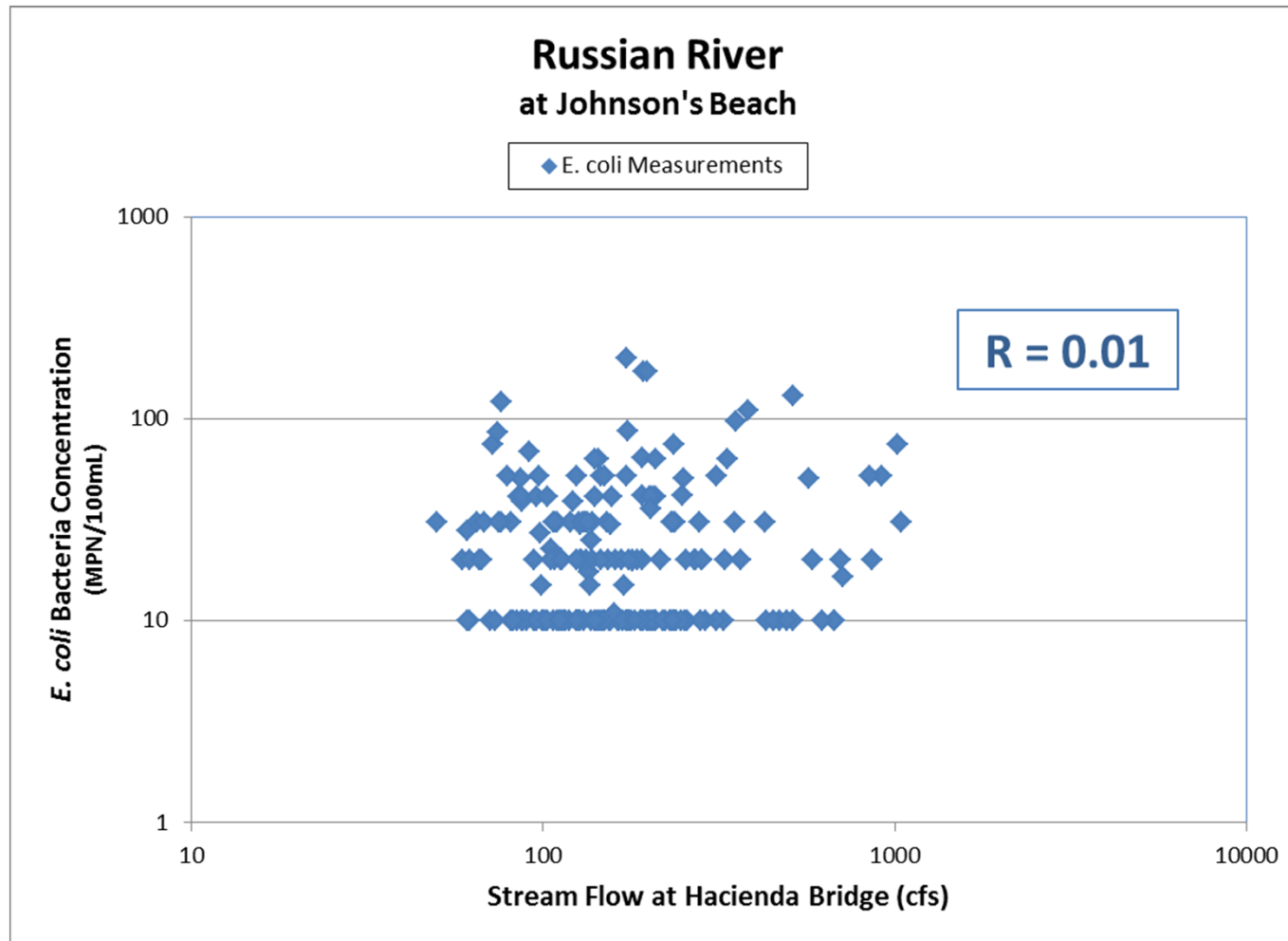
rfitzgerald@waterboards.ca.gov

creed@waterboards.ca.gov









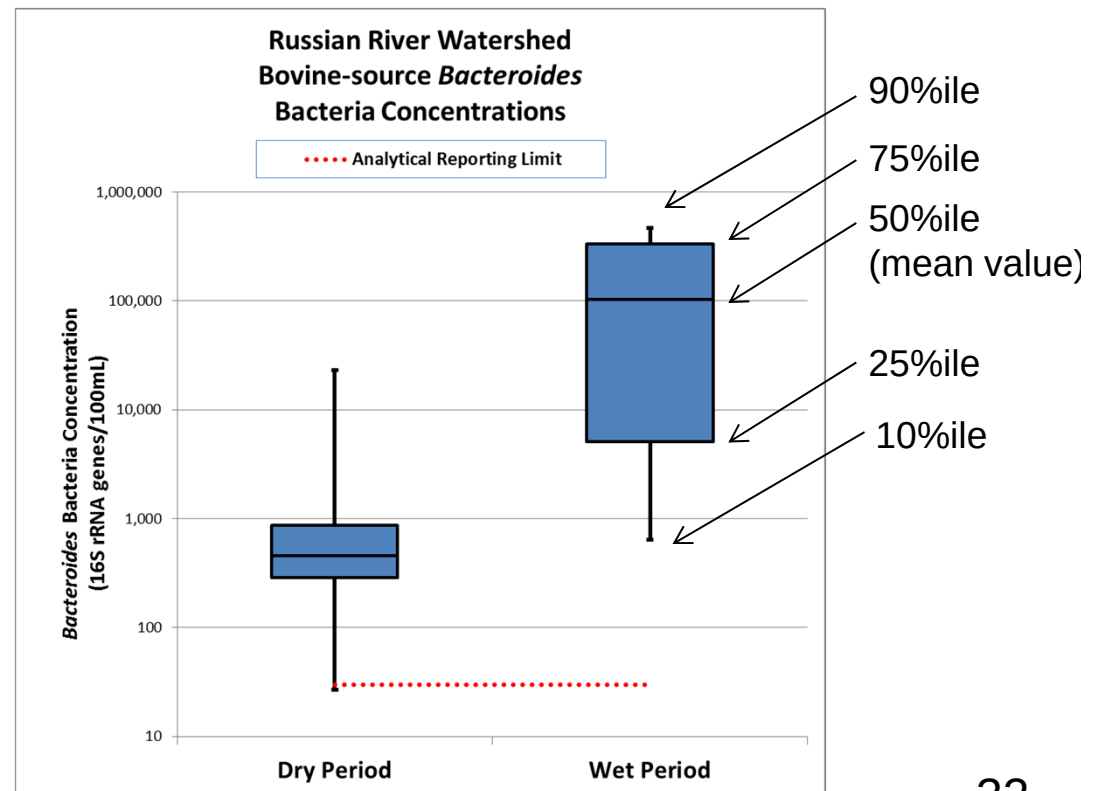
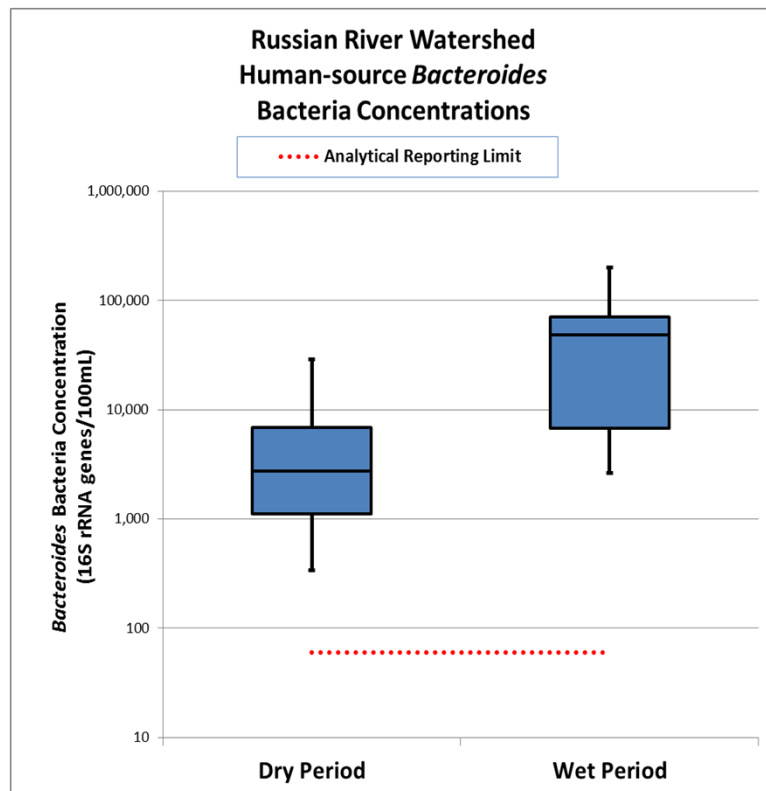


Statistical Hypothesis Tests for Difference between periods 2002-2008 and 2009-2013

Measure ment	Location	Mann- Whitney U Probability	Significant Difference?
<i>E. Coli</i> Bacteria Concentr ation	Steelhead Beach	0.294	No
	Johnson's Beach	0.572	No
Stream Flow	Russian River near Healdsburg	<0.001	Yes
	Russian River near Guerneville	<0.001	Yes

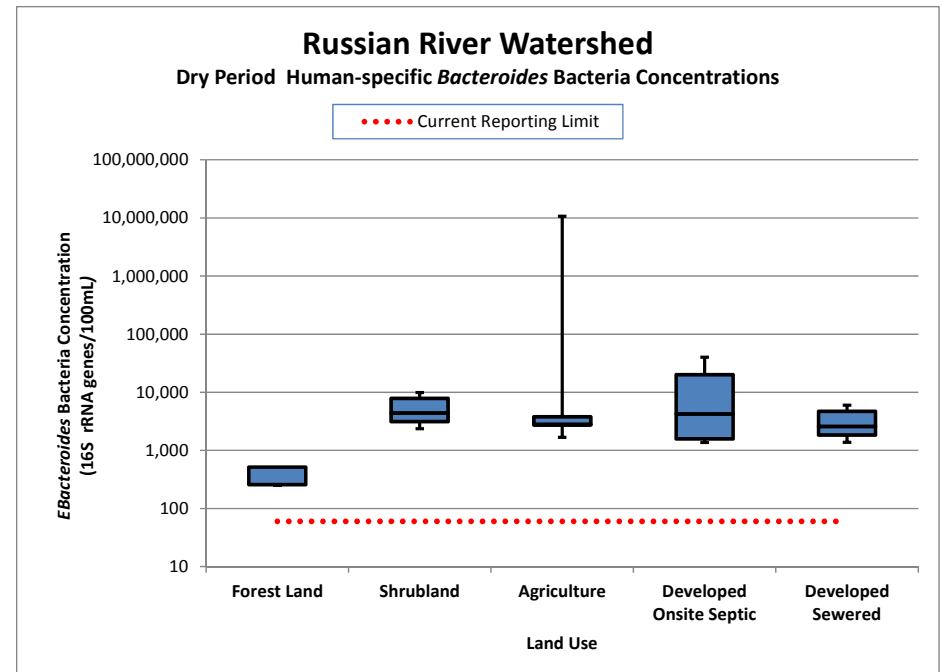
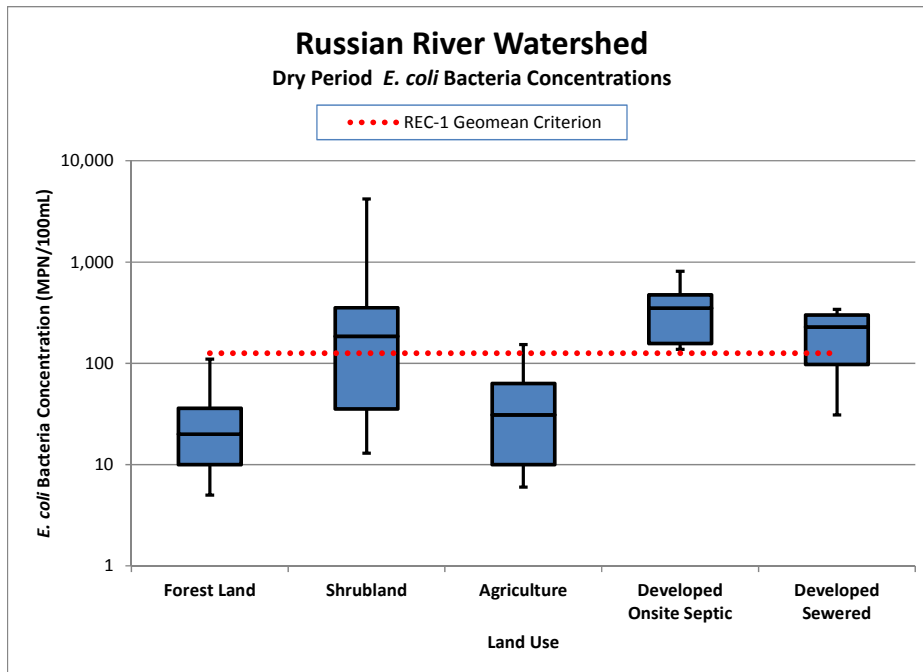
Timing of Source Contributions

- Sources are producing bacteria throughout the year
- Stormwater runoff is mobilizing the bacteria into waterbodies



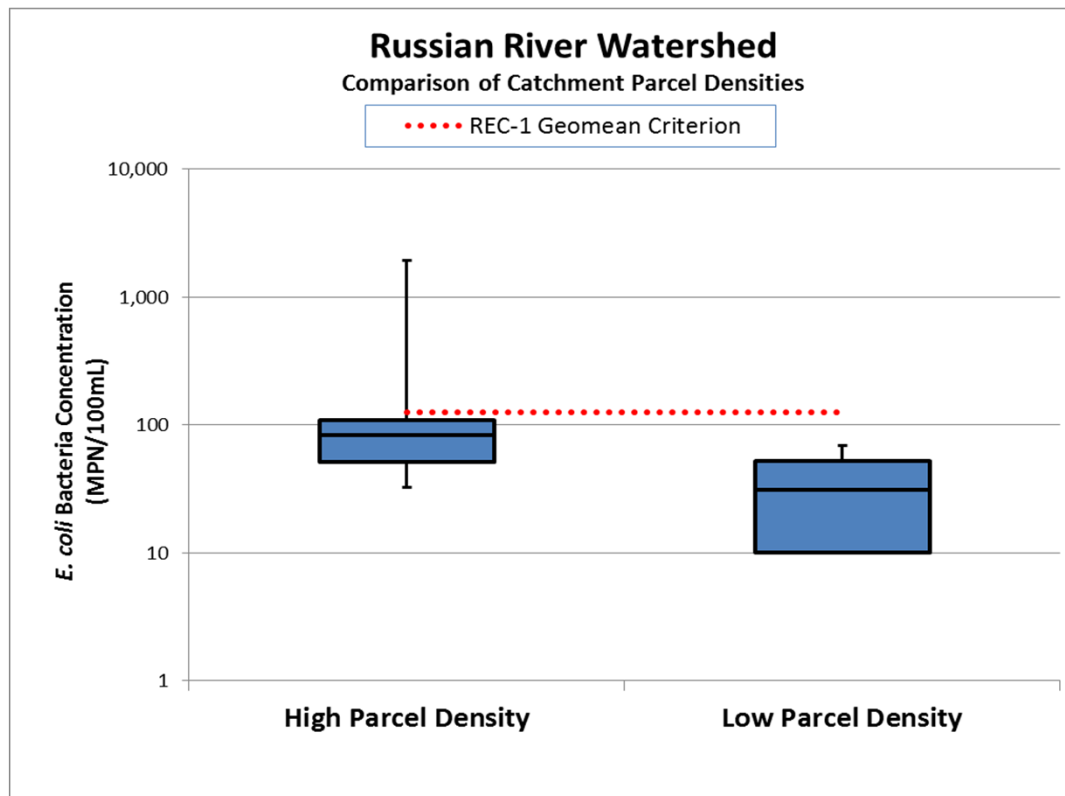
Sources by Land Cover

- Bacteria levels are higher in developed areas than in less developed areas



Sources from Onsite Systems

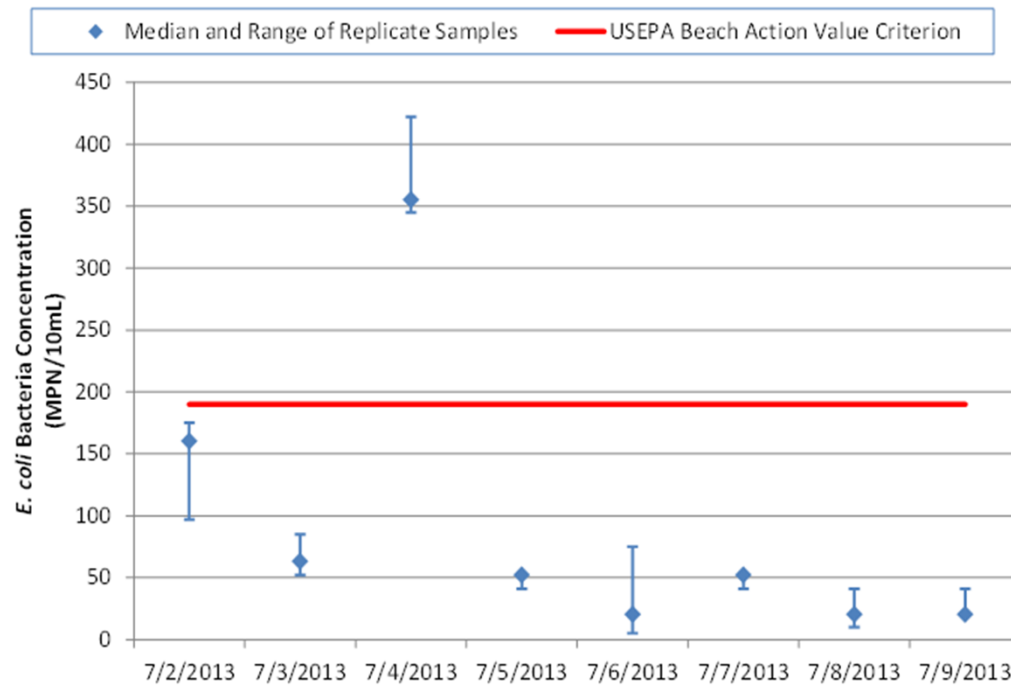
- Bacteria levels are higher in runoff from catchments with a high density of onsite wastewater treatment systems than from areas with a low density of systems



High Parcel Density:
0.76 to 3.99 parcels/acre

Low Parcel Density:
0.01 to 0.11 parcels/acre
or
100 ac. to 10 ac. parcels

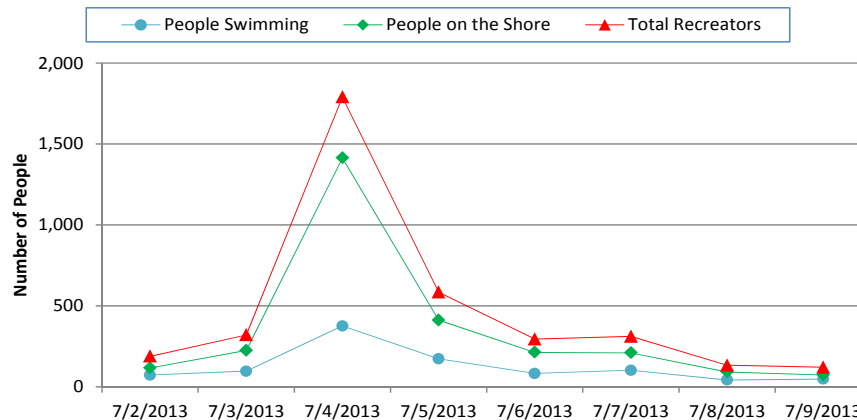
Veteran's Memorial Beach in Healdsburg *E. coli* Bacteria Concentrations



Beach Recreation Sources

- High recreational uses can result in high bacteria levels

People Recreation Counts Veteran's Memorial Beach at Healdsburg



Potential Human Pathogens Detected in the Russian River Watershed

Pathogenic Bacteria Species	Number of Locations with Detected Species		Percent of Samples with Detected Bacteria
	Mainstem	Trib	
<i>Klebsiella pneumoniae</i>	10	23	42%
<i>Proteus mirabili</i>	1	10	11%
<i>Salmonella enterica</i>	1	9	10%
<i>Serratia marcescens</i> (bladder infections)	3	27	41%
<i>Shigella flexneri</i>	0	15	16%
<i>Staphylococcus epidermidis</i>	3	13	22%
<i>Staphylococcus haemolyticus</i>	2	0	2%
<i>Streptococcus sp.</i>	0	8	8%
<i>Vibrio cholerae</i>	0	1	1%
<i>Yersinia sp.</i> (plague)	4	7	15%

These results show a list of bacteria species found in the Russian River watershed that have the potential to be human pathogens and cause illness. The human health risk associated with the presence of pathogenic bacteria is unknown since detection of a pathogenic species does not necessarily indicate that illness will occur. Some pathogenic bacteria are only pathogenic under certain circumstances, such as contact with an open wound. Additionally, there can be more than one strain of a particular bacterium species, and not all strains are pathogenic.